# THE LONGEVITY OF MEMBERS OF THE DIFFERENT CASTES OF TERMOPSIS ANGUSTICOLLIS.

HAROLD HEATH.

Nearly five years have elapsed since I published an account[1] of the breeding habits of three species of California termites, and in this interval it has been possible to add a few facts relating chiefly to the age of the members of the various castes of *Termopsis angusticollis*. As was mentioned in the foregoing account, winged forms do not appear in colonies founded by a primary royal pair until the end of the second year though nymphs, that is larvæ with well developed wing buds, may be recognized bebefore the close of the first year. Also in older colonies immature royal individuals, one or two molts removed from the adult condition, may be found in large numbers in nests from which the winged forms are ready to depart. As there is but one flight a year with this species, it follows that some of the members of the primary royalty are over one year of age before they leave the nest. Furthermore, I have in several instances removed from a flourishing colony a small band of soldiers and well developed workers, together with a number of young individuals which have not undergone more than two molts. The development of these last named insects may be followed without any particular difficulty and where they become true royal forms it is usually after they have been more than one year in the nest.

To determine the length of life of the true royal pair after their mating I partially buried a number of pine logs in a favorable situation and covered them with a cage constructed of fine wire netting. In it were placed, previous to the swarming season, a number of colonies housed in glass jars or naturally founded in logs which had been carried in from the fields. The escape of the winged insects from these nests was normal, and in a short time hundreds of royal pairs were engaged in constructing burrows, which, like the resulting colonies, were developed in the customary fashion as I determined from time to time. During the

[1] "The Habits of California Termites," BIOL. BULL., IV., 47-64.

same period many naturally established nests were located, both at Pacific Grove and about Stanford University, and served to check up results.

In some instances the death of one or both of the royal pair, whether free or in captivity, took place before three years had elapsed; but in certain cases this was undoubtedly due to an unfavorable habitat occasioned by excessive drought or moisture or more often to the ravages of *Termes lucifugus*. Beyond this time their destruction could not so readily be traced to adverse conditions, and may rather be due to exhaustion produced by the arduous duties attendant upon the development of a healthy flourishing progeny. A careful examination showed that at the end of four and one half years the greater number of the kings and queens had died, not over 10 per cent. remaining. After five years I was able to find only six colonies, out of two hundred and thirteen, in which royal forms were present, and but two of these contained both king and queen. In a two-quart fruit jar, which was hermetically sealed and opened only once or twice a year to add water and wood and to remove portions of the continually increasing walls and barricades, I kept a royal pair a few days over five years and eight months. At this time the male died and the queen followed about three months later. From the foregoing it appears that the average life of the royal pair is of at least one year duration in their immature condition, and between four and five after leaving the nest. And further, the life of the male is of practically the same length as that of the female.

To determine the longevity of the workers and soldiers I have in several cases removed from a large colony one or two workers and soldiers which had recently undergone their final molt along with many smaller forms, and have thus been able to distinguish these larger insects from their fellows and to determine their span of life. And again, owing to some slight deformity or some mutilation it has been possible to recognize others in a normally developing colony and to trace their history for years at a time. Also I have taken large communities, headed by true or complemental royal forms, and by removing the young as fast as they appeared, have been able to determine the approximate length of life of all the individuals. From these observations it results

that the workers live about four years after their final molt, and it is probable that this completed state is reached during a period of at least one year, so their life is terminated at the end of about five years.

The soldiers I have been unable to keep, in a great majority of cases, more than three years in a fully developed condition. In a few colonies I have kept them more than four years, and in the nest in the hermetically sealed jar two soldiers lived to be nearly five years of age. Generally speaking the average life of the soldier is about four years from the time of hatching.

While making these observations concerning the formation of the colony and its subsequent development, I have conducted a number of experiments to discover if possible the mode of formation of the various castes. A careful examination of the eggs and the newly hatched young fails to disclose differences which appear to be correlated in any way whatsoever with those distinguishing the soldier, worker and perfect insect to which they give rise. Grassi and Sandias,[1] and others with whom I agree, are of the opinion that it is a question of nutrition ; that the royal pair or the workers by judicious feeding direct the course of development along particular lines. I believe that theoretically all of the young are destined to become perfect insects, but in many cases their growth is arrested or modified and complemental royal forms or soldiers or workers result. Under certain circumstances the modification is not perfect and monstrous forms result, such as soldiers with wings and the ability to produce eggs which may develop. In the examination of many hundreds of colonies formed originally under natural conditions I have found a few such monstrosities, and the surroundings invariably suggest that they have developed under unnatural conditions. In most cases they have appeared in small fragments of wood, which have broken off from the main trunk inhabited by an extensive colony invariably headed by complemental royal forms. With the separation of a small portion of a community changed conditions must arise. New complemental royal forms and in certain cases additional soldiers have to be produced, and it is reasonable to suppose that the enlargement of the nest and the care of the eggs and the developing young demand a profound readjustment

[1] "Costituzione e Sviluppo della Società dei Termitidi," Catania, 1893, 150 pp.

of the conditions obtaining under the old regime. It is accordingly not difficult to imagine that during this transition period the usual mode of feeding of certain individuals may be interfered with and unusual structures result.

In every case these unnatural types are imperfectly developed. For example, the wings of the soldiers are, so far as my experience goes, of less than average size, being in all but two cases less than the length of the abdomen. The reproductive organs likewise are imperfect. In one specimen one half of the ovary was partially functional, the other being in an abortive condition. In two other examples there was an incomplete development of both sides. The mandibles also are of less than average size though within the range of variability which Dr. Desneux writes me is extraordinarily great.

While appearances suggest that these unusual individuals are produced as a result of disturbed conditions, chiefly if not altogether connected with the food and method of feeding, there is no definite proof to show that such is actually the case. For several years I have carried on feeding experiments in the hope that some light might be shed on this important problem, but up to the present time the results are purely negative. I have fed hundreds of immature individuals, which had not undergone more than two molts, entirely or in part upon material carefully removed from the stomach of worker termites and in some instances mixed with fragments of the salivary glands, but such a diet is not perfect, or at all events the mode of feeding is too crude, for the insects soon die and cleared mounts show the alimentary canal to be practically empty. Older individuals live for a longer time on such fare but finally they likewise grow feeble and die. At other times I have fed young and old termites on proctodeal food but the results are never positive. Again I have added to sawdust, upon which these insects thrive, varying quantities of different salts, especially those used in experiments on chemical fertilization, and in other cases have used different acids of various strengths. In other experiments I have mixed the fragmented wood with many substances, nutritious and innutritious intended to disturb the nutritive processes in some degree, but here too, the animal may flourish or starve yet otherwise exhibit no unusual modifications.